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Cirrus Regional Study of Tropical Anvils and Cirrus Layers - Florida Area Cirrus Experiment (CRYSTAL-FACE), a scientific mission

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To make a more accurate computer model of Earth's climate, about 450 scientists from NASA and many other organizations are studying tropical cirrus clouds in the Florida region during July 2002. Researchers are using six aircraft equipped with state-of-the-art instruments to measure characteristics of clouds and their influence on temperatures on Earth. Satellites and ground-based instruments also will play a role in the experiment.

Experimenters are conducting studies in the tropics because solar energy absorption there is the heat engine that drives the world's atmospheric circulation. The clouds under study are cirrus clouds that form in the tropics. Cirrus clouds are high, cold clouds made of ice crystals. They form at altitudes of 30,000 to 60,000 ft. (9-18 km).

Cirrus-cloud ice crystals trap and scatter incoming sunlight, reducing the amount that reaches the Earth's surface. This results in surface cooling.

Cirrus clouds also absorb upwelling infrared radiation emitted by the surface and lower atmosphere.

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Indirectly, this produces a surface-warming effect by trapping heat, energy that might otherwise escape into outer space. Infrared radiation is that part of the electromagnetic spectrum that ranges from 0.7 to 1,000 micrometers. Often, this radiation results from heat exciting matter, vibrating its molecules.

The warmth of the planet's surface also causes liquid water to evaporate resulting in an increase of water vapor in the atmosphere, leading to additional surface warming. Water vapor, like carbon dioxide and ozone, are 'greenhouse gases.' These gases are strong absorbers of infrared radiation, and therefore trap heat in Earth's atmosphere. (Nitrogen and oxygen gas, on the other hand, do not absorb much infrared.)

The CRYSTAL-FACE mission results also will help scientists to better understand the processes controlling water vapor concentrations in the atmosphere, which have increased in the last decade.

The net effect of tropical cirrus clouds on a region's surface temperature depends on several factors, including cloud height, thickness and ice crystal sizes.

The uncertainty of climate prediction by current computer 'models' of Earth's weather, called 'general circulation models,' results from a lack of knowledge of exactly how clouds affect temperature and other atmospheric conditions. Accurately representing clouds in computerized models of weather is challenging today because of our limited knowledge of tropical cirrus cloud physical properties and processes.

CRYSTAL-FACE scientists will study tropical cirrus clouds using a combination of measurements and computer modeling.

Researchers will examine the effects of increased greenhouse-gas concentrations on the formation of tropical cirrus clouds. Increased greenhouse-gas concentrations cause higher temperatures that, in turn, cause more intense convection. Convection in the atmosphere is the up or down circulation of air that plays a role in cloud formation. Scientists also will study the role of convection within clouds.

Researchers plan to characterize convective systems in terms of structure, 'mass fluxes' and updraft velocities.

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A mass flux, or flow, of cloud circulation can represent 'moist convection,' and includes movement of several cloud layers, one of which is a middle layer where rain and droplets of water often form.

Scientists will use airborne and ground-based Doppler radar to help study convection. Doppler radar is radar that can very accurately determine the velocity of moving objects, including cloud particles. Remote sensing of the conditions of the clouds and atmosphere will also take place from other instruments, both aboard satellites and on the ground.

Of the six aircraft to be used during the study, two are NASA airplanes. The high-flying ER-2 is based at NASA Dryden Flight Research Center, Edwards, Calif.; and the WB-57 is from NASA Johnson Space Center, Houston.

Additional, detailed information about the CRYSTAL-FACE mission is on the World Wide Web at: http://cloud1.arc.nasa.gov/crystalface/index.html

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